Sub:	Sensors and Transducers							Code:	21EE641
Date:	09-07-2024	Duration:	90 mins	Max Marks:	50	Sem:	6th A & B	Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE	
			CO	RBT
1	Explain briefly R-2R ladder D/A converter and PWM.	10	CO5	L2
2	Explain the working of a multi-channel analog multiplexed data acquisition system.	6	CO5	L2
	What are the functions of signal conditioning systems?	4	CO4	L1
3	Define data acquisition system. State the objectives of Data acquisition system. Write a note on data acquisition system application.	10	CO5	L1
4	With the circuit diagram explain position telemetry system, Mention its advantages.	10	CO5	L2
5	Explain hydraulic transmission and pneumatic transmission used in data transmission.	10	CO5	L2
6	With the circuit diagram explain Pirani Vacuum gauge.	10	CO6	L2
7	Explain briefly amplitude and frequency modulation.	10	CO5	L2

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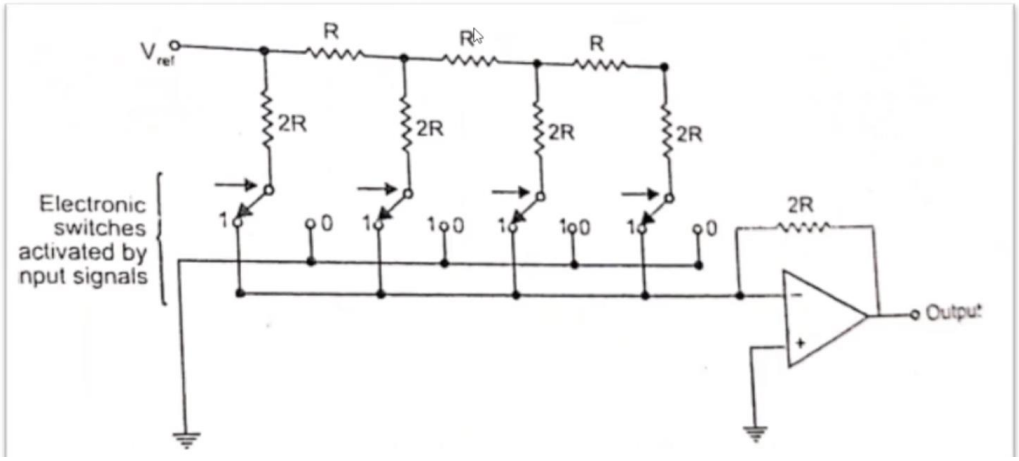
IAT II Qp and soln(Sensors and Transducers_21EE641)

1. Explain briefly R-2R ladder D/A converter and PWM.

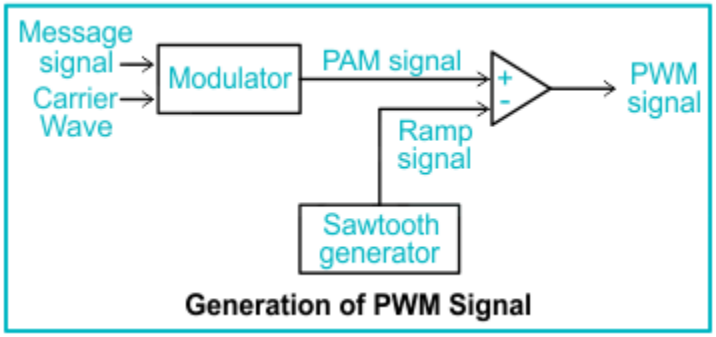
R-2R Ladder network



R-2R Ladder network

- This version overcome the problem of obtaining the accurate resistances over a wide range of values , only **two values** being required.
- Output voltage is generated by switching sections of the ladder to ***either the reference voltage or 0 V according to whether there is a 1 or 0 in a digital input.***

PWM



- The process begins with a message signal and a carrier waveform being input into a modulator, resulting in the creation of a Pulse Amplitude Modulated (PAM) signal.
- This PAM signal is then directed to the non-inverting input of a comparator.

- Simultaneously, a ramp signal generated by a sawtooth generator is directed to the inverting input of the same comparator.
- The two signals are combined and compared with a reference voltage within the comparator circuit.
- The comparator's settings are adjusted to ensure that the reference voltage intersects with the slope of the waveform.
- The initiation of the Pulse Width Modulation (PWM) pulse coincides with the starting edge of the ramp signal, and the duration of the pulse is determined by the workings of the comparator circuit.
- The length of the PWM signal is directly related to the portion of the ramp signal that is not included, as determined by the comparator's level

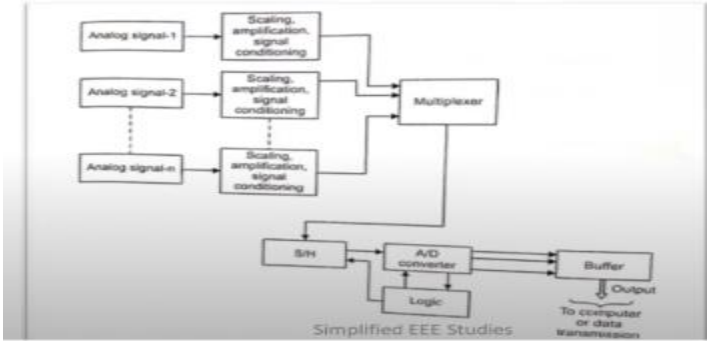
Working of Pulse Width Modulation

A comparator can be used to produce a PWM signal. A sawtooth or non-sinusoidal wave is sent into one input of the comparator and a modulating signal into the other. The comparator creates a PWM signal by comparing the two input signals. The output of the PWM signal depends on the saw-tooth signal's magnitude. If the saw-tooth signal is greater than the modulation signal, the PWM wave will have a high output and vice versa.

2. Explain the working of a multi-channel analog multiplexed data acquisition system.

iv. Multi channel Analog Multiplexing System

- Individual signals are applied after *signal conditioning*.
- These analog signals are converted into digital signal using *ADC.*
- For the best utilization of time, multiplexer is made to seek the next channel to be converted while the previous data stored in S/H.
- After completion of conversion, S/H switched to hold mode.

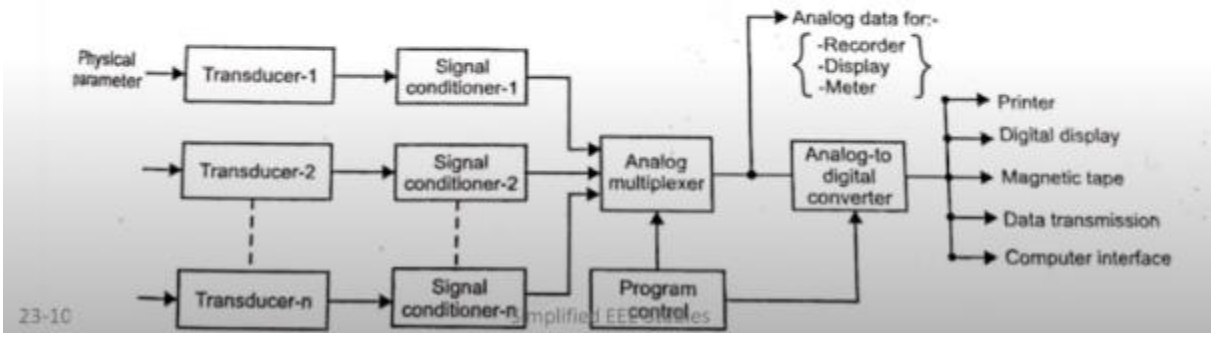


2. What are the functions of signal conditioning systems?

- Protection
- Getting right type of signals
- Getting correct level of signals
- Elimination of Interferences
- Manipulation of signals

3. Define data acquisition system. State the objectives of Data acquisition system.Write a note on data acquisition system application.

- Data acquisition systems may be defined as a system for data processing, data conversion, data transmission and data storage.



Need (Objectives) of data acquisition system:

- To acquire the necessary data at correct speed & correct time.
- To be able to compute performance using on-line & real time data.
- To make use of all data efficiently & systematically.
- To summaries data.
- To store the data.
- To provide effective human communication system.
- To identify & rectify problems.

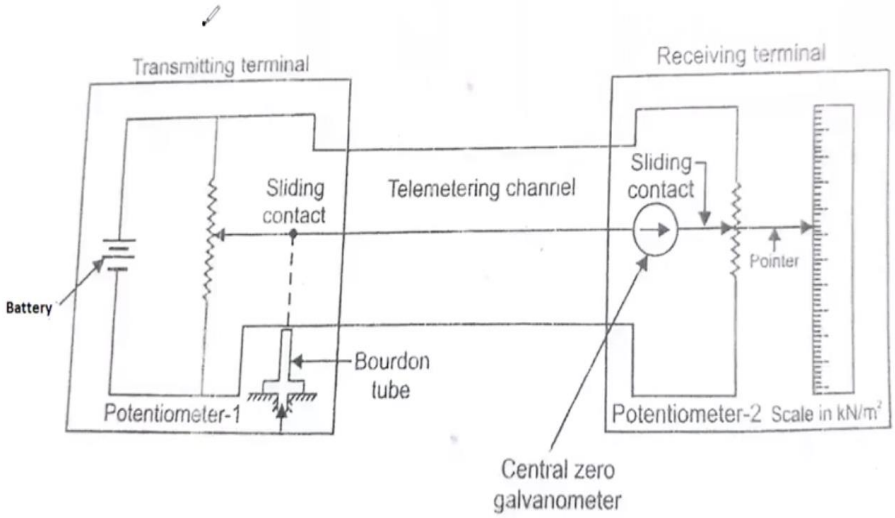
Applications:

A data acquisition system or DAS refers to the combination of hardware and software tools that measure physical parameters from the real world, such as temperature, pressure, sound, motion, etc, and convert the data into digital values that can be saved, analyzed, or transmitted on a computer.

4. With the circuit diagram explaining the position telemetry system, Mention its advantages.

- This system *transmits and reproduces* measured variable in terms of *positioning variable* with the help of potentiometer arrangement shown in the diagram.
- There are *two potentiometers arranged* in transmitter and receiving end respectively.
- Both potentiometers are operated under *common power supply.*

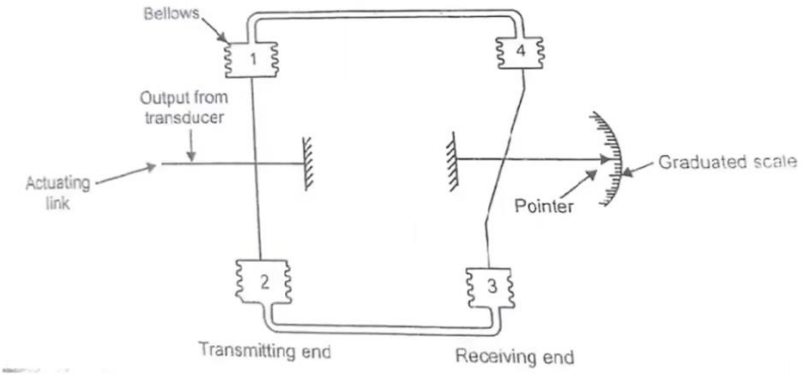
Position (Ratio) Telemetering System



5. Explain hydraulic transmission and pneumatic transmission used in data transmission.

Data/Signal Transmission

Hydraulic method



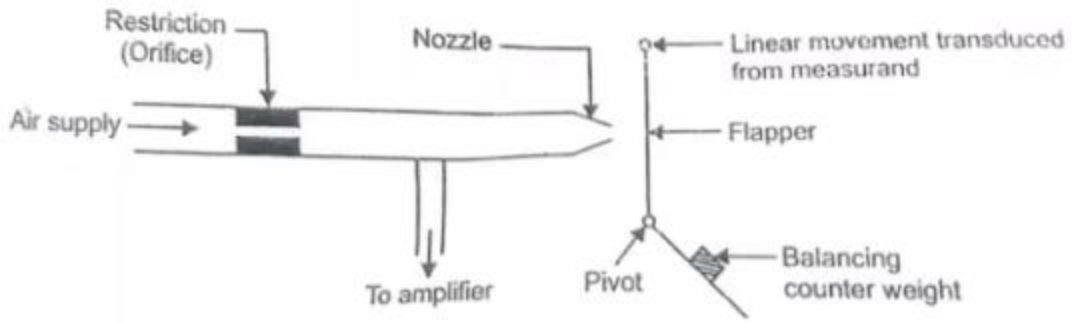
-Generally called Mechanical Transmission

-short distance (max. 200m)

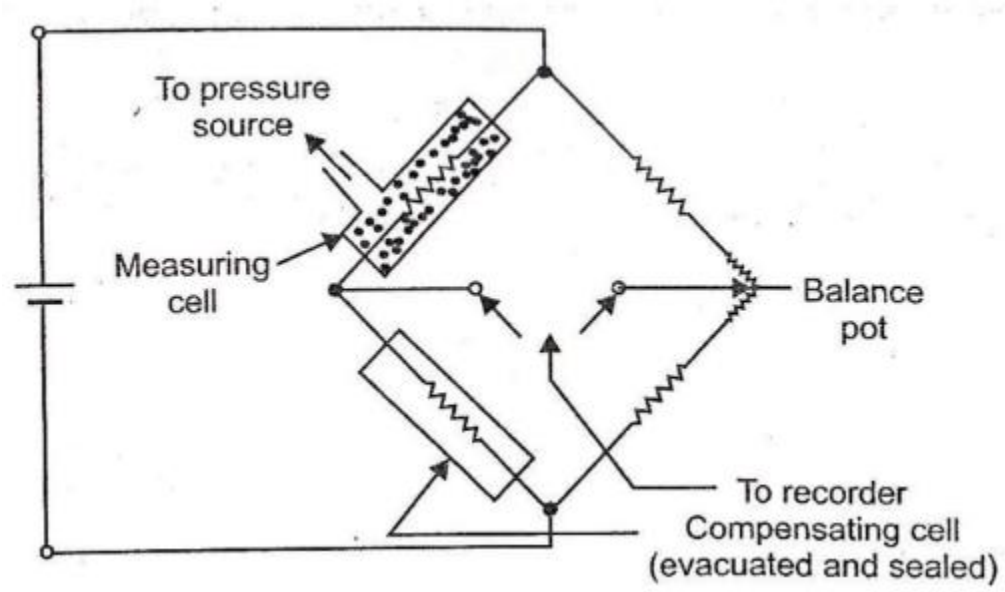
- There are *four bellows*.
- Two bellows at *transmission end* and another two at *receiving side*.
- Four bellows connected with *impulse pipeline*.
- Liquid flows through *impulse pipe.*
- Actuating link operating at transmission end.
- During operation *one bellow is expanded* and *other bellow is contracted.*
- This expansion & contraction communicated to receiving end.

Pneumatic methods

- Flapper nozzle mechanism.
- Open nozzle supplied air through orifice.
- Flapper is linked with measurand.
- Force on the flapper produced by the transducer convert the measurand into linear displacement.



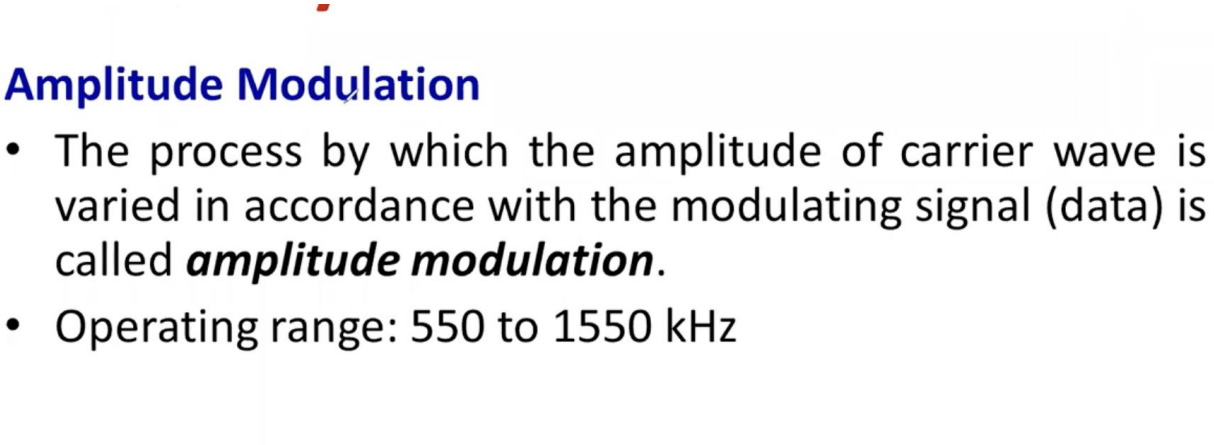
6. With the circuit diagram explain Pirani Vacuum gauge.



The Pirani gauge consists of a metal filament (usually platinum) suspended in a tube which is connected to the system whose vacuum is to be measured. Connection is usually made either by a ground glass joint or a flanged metal connector, sealed with an o-ring. The filament is connected to an electrical circuit from which, after calibration, a pressure reading may be taken. A conducting wire (platinum filament) gets heated when electric current flows through it. This wire suspended in a gas will lose heat to the gas as its molecules collide with the wire and remove heat. As the gas pressure is reduced (by the vacuum pumps) the number of molecules present will fall proportionately, the conductivity of the surrounding media will fall and the wire will lose heat more slowly. Measuring the heat loss is an indirect indication of pressure.

The electrical resistance of the wire varies with its temperature, so the measurement of resistance also indicates the temperature of wire. Now the change in resistance of the filament is determined using the bridge. This change in resistance of the pirani gauge filament becomes a measure of the applied pressure when calibrated. In many systems, the wire is maintained at a constant resistance R by controlling the current I through the wire. The resistance can be set using a bridge circuit. The power delivered to the wire is I 2 R, and the same power is transferred to the gas. The current required to achieve this balance is therefore a measure of the vacuum.

7. Explain briefly amplitude and frequency modulation.



Amplitude modulation is the process in which the wave signals are transmitted by modulating the amplitude of the signal. The amplitude modulation is often called AM. This technique was established by Landell de Moura and Reginald Fessenden in the 20th century when conducting radiotelephone experiments. It is used to transfer information through a radio wave. It is mostly used in electronic communications like portable two-way radios, citizens band radio, VHF aircraft radio, etc.

$Y(t) = A \sin(\omega ct) + A\,M2\sin((\omega c + \omega m)\,t + \varphi) + A\,M2\sin((\omega c - \omega m)\,t - \varphi)$

Where,

C is the carrier amplitude

φ is the phase signal of the initial reference time

M is the carrier amplitude

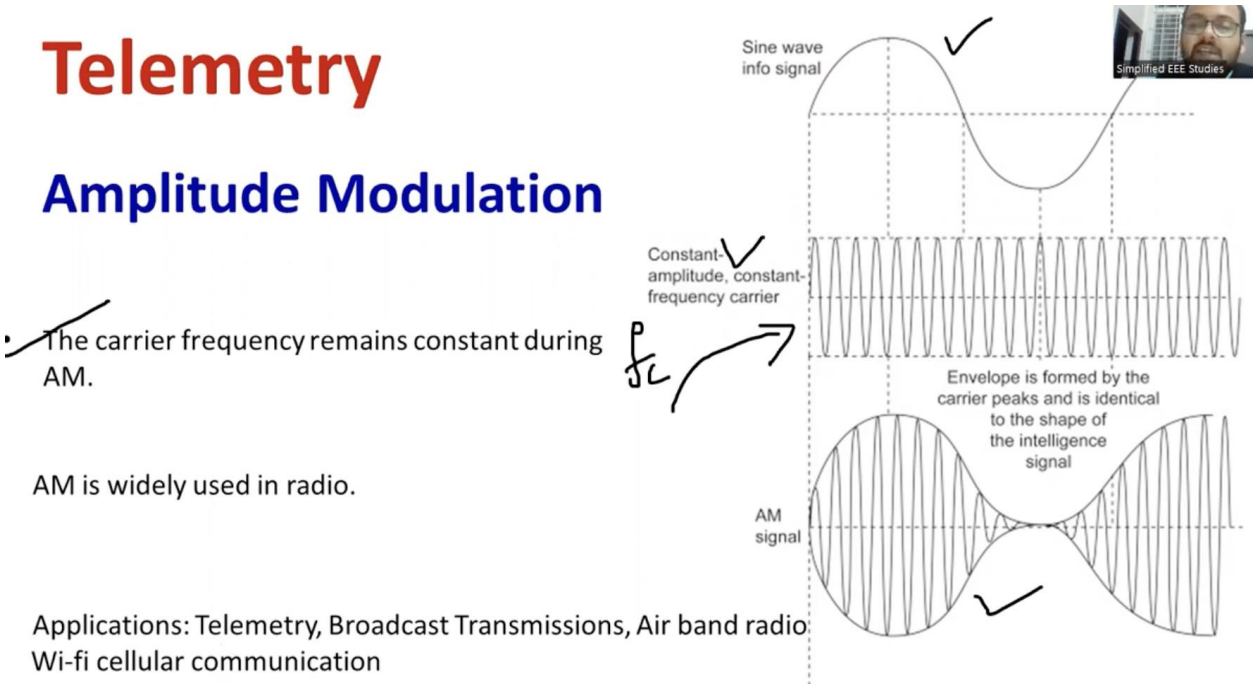
Modulation Index (μ) = Ac / Am

Ac is the amplitude of carrier wave

Am is the amplitude of modulating signal

Amplitude Modulation (AM):

- **Definition:** AM involves varying the amplitude of a carrier wave in accordance with the amplitude of the input signal (the signal to be transmitted).
- **Process:** The carrier wave's amplitude is made to fluctuate (modulated) in proportion to the changes in the amplitude of the input signal.
- **Usage:** AM is commonly used in broadcasting, such as in AM radio transmissions, where variations in amplitude represent the audio signal



Frequency Modulation

Frequency modulation is the process of encoding information on a particular analogue or digital signal by varying the carrier wave frequency in accordance with the frequency of the modulating signal. The Frequency Modulation is often called FM. As we know, a modulating signal is the transmitting of information or message after being converted into an electronic signal.

$m(t) = A_m \cos(\omega_m t + \Theta)$

Where,

m(t) is the modulating signal

Am is the amplitude modulating signal

ωm is the angular frequency

Θ is the phase of the modulating signal

Frequency Modulation (FM):

- **Definition:** FM involves varying the frequency of a carrier wave in response to the amplitude of the input signal.
- **Process:** The frequency of the carrier wave is modulated based on the changes in amplitude of the input signal.
- **Usage:** FM is widely used in FM radio broadcasting and also in various forms of data transmission, where the frequency variations represent the information being transmitted.